REMARKS

In an Office Action mailed December 26, 2002, the Examiner has: (i) rejected claims 58, 59, 61-63, 72-80, and 89-91 under 35 U.S.C. §102(b) as being anticipated by Fuesser et al. (U.S. Pat. 5,628,920), (ii) rejected claims 58, 59, 61-63, 72-80, and 89-91 under 35 U.S.C. §102(b) as being anticipated by Miyanaga et al. (U.S. Pat. 5,397,558), (iii) rejected claims 60, 64-67, and 81-88 under 35 U.S.C. §103(a) as being unpatentable over Miyanaga et al. or Fuesser et al., (iv) rejected claims 68-71 under 35 U.S.C. §103(a) as being unpatentable over Miyanaga et al. or Fuesser et al. both in view of Kulisch (U.S. Pat. 5,246,198), and (v) rejected claims 92-93 under 35 U.S.C. §103(a) as being unpatentable over Miyanaga et al. or Fuesser et al. both in view of Gruen (B 2.3).

In this response, Applicants' have cancelled claims 58, 64-65, and 89, amended claims 59, 61, 66, 77-78, 83-87, and 90-91, and added new claims 94-95. Thus, claims 59-63, 66-88, and 90-95 are pending. No new matter is added by entry of these amendments.

Section 102(b) Rejections

The Examiner has rejected claims 58, 59, 61-63, 72-80, and 89-91 under 35 U.S.C. §102(b) as being anticipated by Fuesser et al., and by Miyanaga et al.

The Fuesser et al. reference teaches a process for surface treating an organic layer to prepare it for the subsequent coating with a cover layer which is harder than the organic layer. The process comprises providing growth nuclei for the cover layer on the surface of the orgainic layer, where the growth nuclei are formed of material which exhibits sp^2 or sp^3 bonding orbital hybridization. Col. 2, lines 6-14, col. 3, lines 17-22, and col. 4 lines 37-43. If a layer of diamond and/or diamond-like material is to be deposited as the cover layer, then adamantane and/or congressane (diamantane) and/or organic molecules which contain homologs of the series of sp^2 hybridizing carbon compounds are advantageously used as growth nuclei. Col. 3, lines 28-32.

In contrast, the present process as claimed comprises nucleating the growth of a diamond film with a higher diamondoid. As defined in the specification at page 9, line 30 to page 12, line 31, the term "lower diamondoid" refers to any of the molecules adamantane, diamantane, and triamantane. The term "higher diamondoid" refers to any of the molecules tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane components, as well as mixtures, isomers and stereoisomers of those molecules. Lower diamondoids show no isomers or chirality and are readily synthesized, distinguishing them from higher diamondoids. See the specification at page 10, lines 7-10.

Thus, the Fuesser et al. reference teaches nucleating a diamond with the lower diamondoids adamantane and diamantane, and does not teach a process of nucleating the growth of a diamond film with a higher diamondoid.

Similarly, the Miyanaga et al. reference teaches a method of forming a diamond film from a gas of the organic compounds adamantane, diamantane, and triamantane. Col. 3, lines 7-19, FIGS. 5A-5C, and claim 2. Adamantane, diamantane, and triamantane are lower diamondoids. The Miyanaga et al. reference does not teach a method of nucleating the growth of a diamond film with a higher diamondoid, as in the present claims as amended.

Thus, it is believed that claims 59, 61, 90, and 91 are not anticipated by either the Fuesser et al. or the Miyanaga et al. reference. Since claims 62-63, and 72-80 depend from claim 61, claims 62-63 and 72-80 are not anticipated as well.

Section 103(a) Rejections

The Examiner has rejected claims 60, 64-67, and 81-88 as being unpatentable over Miyanaga et al. or Fuesser et al., rejected claims 68-71 as being unpatentable over Miyanaga et al. or Fuesser et al., both in view of Kulisch, and rejected claims 92-93 as being unpatentable over Miyanaga et al. or Fuesser, both in view of Gruen.

The structures, shapes, and properties of the higher diamondoids are vastly more variable than those of the lower diamondoids, and not well understood in the art. Adamantane, which is commercially available, has been studied extensively. In contrast, the higher diamondoids have received comparatively little attention in the scientific literature. To the Applicants' knowledge, *anti*-tetramantane is the only higher diamondoid that has even been synthesized to date.

While there is only one isomeric form of each of the lower diamondoids (adamantane, diamantane, and triamantane), there are four different isomers of tetramantane; in other words, four mathematical ways of arranging the adamantane subunits to "construct" the tetramantane molecule. Moreover, the number of possible isomers increases non-linearly with each member of the higher diamondoid series above tetramantane; i.e., pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, etc.

For example, there are ten possible pentamantanes, nine having the molecular formula $C_{26}H_{32}$, and among these nine there are three pairs of enantiomers. There also exists a pentamantane represented by the formula $C_{25}H_{30}$. Hexamantanes exist in thirty-nine possible structures with twenty eight having the formula $C_{30}H_{36}$, ten hexamantanes have the formula $C_{29}H_{34}$ and the remaining hexamantane has the formula $C_{26}H_{30}$. Heptamantanes are postulated to exist in 160 possible structures with 85 having the molecular formula $C_{34}H_{40}$ and of these, seven are achiral, having no enantiomers. Of the remaining heptamantanes 67 have the molecular formula $C_{33}H_{38}$, six have the molecular formula $C_{32}H_{36}$, and the remaining two have the molecular formula $C_{30}H_{34}$.

The complexity increases at an even faster rate from the heptamantanes. Octamantanes possess eight of the adamantane subunits and exist with five different molecular weights. Nonamantanes exist within six families of different molecular weights; decamantanes within families of seven different molecular weights, and so on. See the specification at page 9, line 21 to page 12, line 31.

This extraordinarily large variation in size, shape, and molecular weight, even among members of any one homolog of the higher diamondoid series, produces a correspondingly wide variation in chemical and physical properties. Such properties include density, surface-to-volume ratio, carbon-to-hydrogen ratio, crystallographic orientation of exterior surfaces, and degree of hydrogenation, to mention a few. The corresponding derivatized or substituted higher diamondoids are expected to display a wide variation in properties as well, due to differences in attachment sites, both in terms of chemistry and steric hindrance.

The manner in which these chemical and physical variations will affect diamond nucleation has not been addressed in the art. Moreover, it is not believed that routine experimentation is sufficient to determine optimum higher diamondoid nucleation conditions, as the parameters affecting nucleation are very complex. It may even be appropriate to determine optimum nucleation conditions on a case-by-case basis, depending on the crystallographic orientation, grain size, growth rate, etc., that one desires in the resulting diamond film.

The advantages offered by the claimed invention include greater control over the nucleation process, and the ability to build specifically desired properties into the diamond film. The advantages are made possible by the rich chemical and physical diversity of the higher diamondoids.

There is no teaching or suggestion in either the Fuesser et al. or the Miyanaga et al. references to take advantage of the rich diversity and variation in size and shape offered by the higher diamondoids, and it is not believed that routine experimentation is sufficient to determine the "optimum" nucleation conditions using higher diamondoids.

Thus it is believed that claims 59, 61, 90, and 91 as amended are believed to be patentable over Fuesser et al. and Miyanaga et al. Since claim 60 depends from claim 59, claims 62-63 and 66-88 depend from claim 61, and claims 92-93 depend

from claim 91, claims 60, 62-63, 66-88, and 92-93 are believed to be patentable as well.

New Claims 94-95

Support for new claims 94-95 may be found in the specification, among other places, at page 25, lines 25-28.

CONCLUSION

In conclusion, Applicants' have cancelled claims 58, 64-65, and 89, and amended claims 59, 61, 66, 77-78, 83-87, and 90-91 to more clearly recite and distinctly claim Applicants' invention. Thus, claims 59-63, 66-88, and 90-95 are believed to be in condition for patentability. Reconsideration and withdrawal of the Section 102 (b) rejection of claims 59, 61-63, 72-80, and 90-91, and the Section 103(a) rejection of claims 60, 66-71, 81-88, and 92-93 is respectfully requested.

Respectfully submitted,
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Marked-Up Copy of Claims Herein Amended

59. (Twice amended) A method of nucleating the growth of a diamond film, wherein the film is nucleated with at least one [diamondoid selected from the group consisting of triamantane and higher diamondoids] higher diamondoid.

61. (Amended) A method of nucleating the growth of a diamond film, the method comprising the steps of:

a) providing a reactor having an enclosed process space;

b) positioning a substrate within the process space;

c) introducing a process gas into the process space;

d) coupling energy into the process space from an energy source; and

e) injecting at least one higher diamondoid into the process space, wherein the at least one higher diamondoid nucleates the growth of the diamond film on the substrate.

66. (Amended) The method of claim 61, wherein the at least one higher diamondoid is a substituted higher diamondoid.

77. (Amended) The method of claim 61, wherein the injecting step comprises volatilizing the at least one higher diamondoid by heating such that it sublimes into the gas phase.

78. (Amended) The method of claim 77, wherein the injecting step includes entrainment of the sublimed higher diamondoid in a carrier gas which is introduced into the process chamber.

83. (Amended) The method of claim 61, wherein the injecting of the at least one higher diamondoid increases the growth rate of the diamond film by a factor of at least two to three times.

84. (Amended) The method of claim 61, wherein the injecting of the at least one higher diamondoid increases the growth rate of the diamond film by at least an order of magnitude.

85. (Amended) The method of claim 61, wherein the injecting of the at least one higher diamondoid occurs at the beginning of a deposition process.

86. (Amended) The method of claim 61, wherein the injecting of the at least one higher diamondoid occurs during at least part of the growth of the diamond film.

87. (Amended) The method of claim 61, further including the step of selecting a particular higher diamondoid to facilitate the growth of a diamond film having a desired crystalline orientation.

90. (Amended) A diamond film nucleated by at least one [diamondoid selected from the group consisting of triamantane and higher diamondoids] higher diamondoid.

91. (Amended) A diamond film nucleated by the steps comprising:

a) providing a reactor having an enclosed process space;

b) positioning a substrate within the process space;

c) introducing a process gas into the process space;

d) coupling energy into the process space from an energy source; and

e) injecting at least one higher diamondoid into the process space, wherein the at least one higher diamondoid nucleates the growth of the diamond film on the substrate.

94. (New) The diamond film of claim 90, wherein the higher diamondoid is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane.

95. (New) The diamond film of claim 91, wherein the higher diamondoid is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane.